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Energy and Commerce Committee
Subcommittee on Energy

Congressional Testimony of Tyler H. Norris of Duke University
Hearing on *Scaling for Growth: Meeting the Demand for Reliable, Affordable Electricity*
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Good morning, Chairman Latta, Ranking Member Castor, Chairman Guthrie, Ranking Member Pallone, and Members of the Subcommittee. Thank you for the opportunity to testify. I am here today in my personal capacity and not on behalf of Duke University.

My name is Tyler Norris. I am a James B. Duke Fellow at Duke University's Nicholas School of the Environment, where my PhD research focuses on bulk electric power systems. My research is informed by fifteen years of energy sector experience, most recently as vice president of development at Cypress Creek Renewables, a leading US independent power producer, where I managed a multi-gigawatt project portfolio. I was previously a director at S&P Global Platts, an international energy consultancy, where I developed power market forecasts for electric utilities and integrated majors. Prior to S&P, I was a special advisor at the US Department of Energy, where I designed technology commercialization programs.

I am here to testify that the United States can support the orderly integration of new electricity demand, provided we make strategic use of existing infrastructure, provide a stable policy environment, and take a proactive approach to plan and invest in long lead resources. My testimony draws in part from my research as lead author of the recent study, *Rethinking Load Growth: Assessing the Potential for Integration of Large Flexible Loads in US Power Systems*, released in February 2025 by Duke University's Nicholas Institute for Energy, Environment, and Sustainability.[1]

In short, our findings suggest that with modest flexibility from new large electricity customers, the existing US power system can accommodate substantial load additions without compromising reliability. Given the time required to develop new generation and transmission at scale, leveraging the infrastructure we have already will be essential in the near term. Flexibility measures can provide a crucial bridge, buying time and conserving capital while longer-lead resources are planned and built.

My testimony today will cover three topics. First, I will discuss how the existing US power system can quickly integrate large volumes of new electricity load while preserving reliability and affordability. Second, I will review opportunities to accelerate the addition of new generation to grid. Finally, I will outline how these measures can buy time and resources for scaling up long-lead investments, including bulk transmission expansion, clean firm generation, and long-duration energy storage.

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[1] Norris, T. H., T. Profeta, D. Patino-Echeverri, and A. Cowie-Haskell. 2025. Rethinking Load Growth: Assessing the Potential for Integration of Large Flexible Loads in US Power Systems. NI R 25-01. Durham, NC: Nicholas Institute for Energy, Environment & Sustainability, Duke University. https://nicholasinstitute.duke.edu/publications/rethinking-load-growth.

I. The Existing US Power System Can Accommodate Large Load Additions

Limits to Rapid Infrastructure Expansion Demand Broader Solutions

US winter peak load is now forecasted to grow by 21.5% over the next decade, higher than any period since the 1980s.[2] The primary catalyst for this updated forecast is the surge in electricity demand from large commercial customers. While significant uncertainty remains, particularly following the release of DeepSeek, data centers are expected to account for the single largest growth segment, adding as much as 65 GW through 2029 and up to 44% of US electricity load growth through 2028.[3] [4]

This load growth is colliding with barriers to timely resource expansion, including supply chain constraints, restrictive interconnection procedures, and extended permitting processes, among other obstacles. Transformer order lead times have grown to two to five years, up from less than one year in 2020, while costs have surged by 80%.[5] More recently, lead times for gas turbines have reportedly reached four years,[6] with NextEra's CEO stating in a recent earnings call that new gas projects "won't be available at scale until 2030, and then only in certain pockets of the US."[7] Due in part to these constraints, some utilities have quoted interconnection delays for new large loads ranging up to 7 to 10 years.[8] [9]

Today's infrastructure development challenges appear to be more pronounced than in past periods of US load growth, driven by stricter permitting requirements, a diminished manufacturing base, skilled labor shortages, higher population density, and less land availability. The scale and complexity of the challenge underscores the importance of deploying every available tool, especially those that can more swiftly, affordably, and sustainably integrate large loads – particularly amid market pressure for many customers to access the grid as quickly as possible.

In recent months, the US Secretary of Energy Advisory Board and the Electrical Power Research Institute have highlighted a key solution: load flexibility.[10] [11] The promise is that the unique profile of AI data centers can facilitate more flexible operations, supported by ongoing developments in distributed energy resources (DERs) and advanced computational resource management.

Load flexibility refers to the ability of end-use customers to temporarily reduce their electricity consumption from the grid during periods of system stress by using on-site generators, shifting workload to other facilities, or scaling back operations. When system planners can reliably anticipate this load flexibility, the immediate pressure to expand generation capacity and transmission infrastructure can be alleviated, mitigating or deferring costly expenditures. By facilitating near-term load growth without

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[2] NERC. 2024 Long-Term Reliability Assessment. Atlanta: North American Electric Reliability Corporation.

[3] Wilson, J. D., Z. Zimmerman, and R. Gramlich. 2024. Strategic Industries Surging: Driving US Power Demand. Bethesda, MD: GridStrategies. https://gridstrategiesllc.com/wp-content/uploads/National-Load-Growth-Report-2024.pdf.

[4] Rouch, M. A. Denman, P. Hanbury, P. Renno, and E. Gray. 2024. Utilities Must Reinvent Themselves to Harness the AI-Driven Data Center Boom. Boston: Bain & Company. https://www.bain.com/insights/utilities-must-reinvent-themselves-to-harness-the-ai-driven-data-center-boom/.

[5] NIAC. 2024. Addressing the Critical Shortage of Power Transformers to Ensure Reliability of the U.S. Grid. The National Infrastructure Advisory Council. Washington, DC: The President's National Infrastructure Advisory Council.

[6] GEP. 2024. "Navigating Energy Transition Challenges and Supply Chain Innovations." https://www.gep.com/blog/strategy/energy-transition-challenges-supply-chain-innovations.

[7] Arun, A. 2025 "The Natural Gas Turbine Crisis." *Heatmap News*, February 26. https://heatmap.news/ideas/natural-gas-turbine-crisis.

[8] Saul, J. 2024. "Data Centers Face Seven-Year Wait for Dominion Power Hookups." *Bloomberg*, August 29.

[9] WECC. 2024. "State of the Interconnection." Western Electricity Coordinating Council, September. https://feature.wecc.org/soti/topic-sections/load/index.html.

[10] SEAB. 2024. Recommendations on Powering AI and Data Center Infrastructure. Washington, DC: US Secretary of Energy Advisory Board. https://www.energy.gov/sites/default/files/2024-08/Powering%20AI%20and%20Data%20Center%20Infrastructure%20Recommendations%20July%202024.pdf

[11] Walton, R. 2024. "EPRI Launches Data Center Flexibility Initiative with Utilities, Google, Meta, NVIDIA." *Utility Dive*, October 30. https://www.utilitydive.com/news/epri-launches-data-center-flexibility-initiative-with-NVIDIA-googlemeta/731490/.

prematurely committing to large-scale capacity expansion, this approach offers a hedge against mounting uncertainty in the US data center market in light of the release of Deep-Seek.

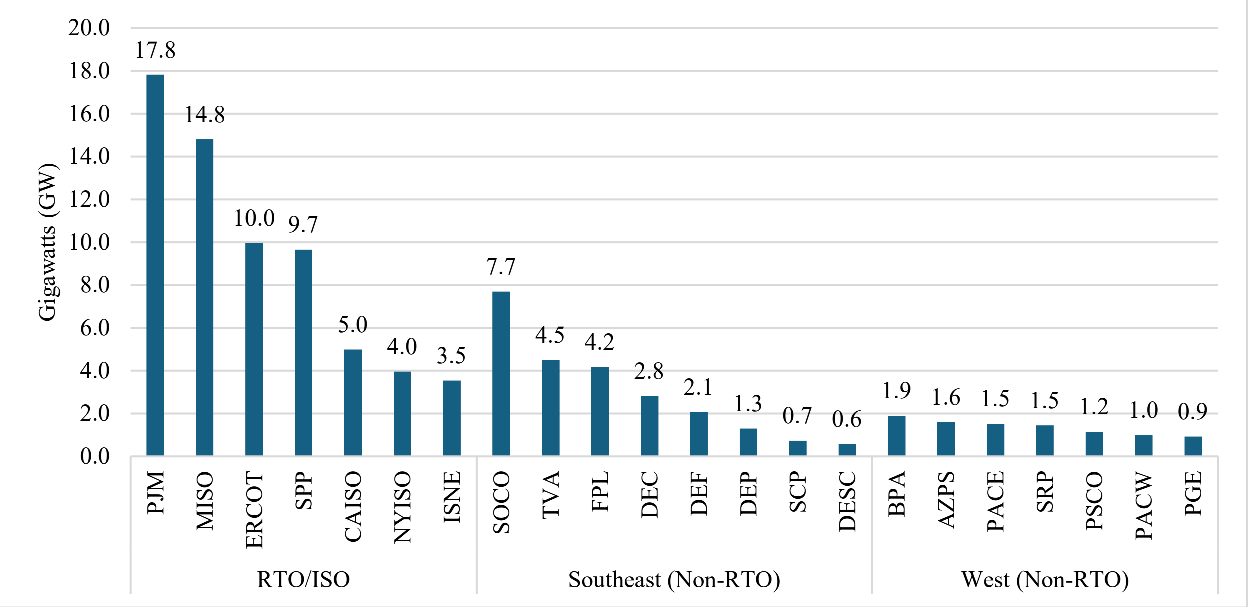
Modest Flexibility from New Loads Can Enable Significant Load Additions

To support the identification of near-term solutions, my colleagues and I recently conducted a study on how the existing US power system can accommodate new loads. The analysis, which encompasses 22 of the largest US balancing authorities serving 95% of the country's peak load, provides a first-order estimate of the volume of new load that could be added before total system-wide load exceeds what grid operators are already prepared to serve, provided the new load can be temporarily curtailed as needed. We term this curtailment-enabled headroom.

Key results include:

- 76 gigawatts (GW) of new load – equivalent to 10% of the nation's peak demand – could be integrated with an average annual load curtailment rate of 0.25% (i.e., if new loads can be curtailed for 0.25% of their maximum uptime)[12]
- 98 GW could be integrated at a 0.5% curtailment rate (Figure 1), and 126 GW at 1.0%
- The average curtailment event lasts about two hours, and nearly 90% of hours during which load reduction is required retain at least half of the new load (i.e., less than 50% curtailment of the new load is required)
- The five balancing authorities with the largest potential load integration at 0.5% annual curtailment are PJM at 18 GW, MISO at 15 GW, ERCOT at 10 GW, SPP at 10 GW, and Southern Company at 8 GW

Figure 1: System Headroom Enabled by 0.5% Curtailment of New Load by Balancing Authority



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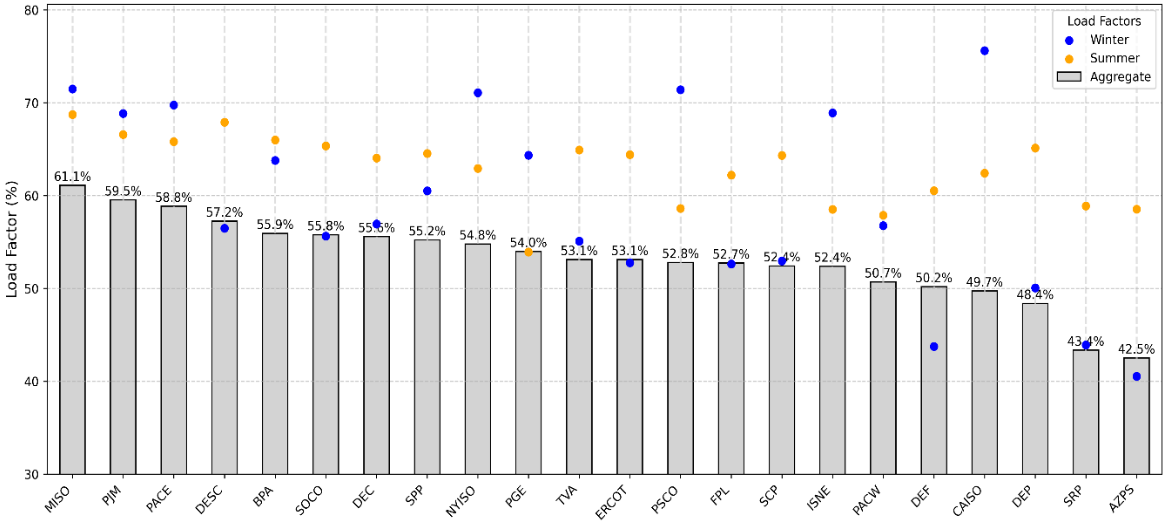
[12] For example, a 100 GW data center with a maximum potential annual electricity use of 876,000 GWh (100 GW * 8760 hrs/year) would need to curtail 0.25% of this consumption from the grid in an average year, totaling 2,190 GWh.

To contextualize these figures, the $500 billion data center megaproject announced by President Trump, Project Stargate, would entail 15-25 gigawatts of new load.[13] In other words, if new AI data centers can adjust their electricity consumption during a limited number of hours when power grids experience peak stress, equivalent to 0.5% of their maximum uptime, the existing US power system could accommodate up to four or five Project Stargates. This is equivalent to more than $2 trillion in data center investment.

These findings suggest that the existing US power system can accommodate significant load additions with limited flexibility measures. This is possible because the grid is designed to handle occasional demand spikes during extreme weather, meaning it operates with spare capacity in most hours. In fact, our analysis found that the average load factor – the utilization rate of the system – is just 53%, indicating that nearly half of US electrical infrastructure remains unused at any given time, on average (Figure 2).

Figure 2: Load Factor by Balancing Authority and Season, 2016–2024



Achieving this potential does not require new technologies but rather more methodical up-front planning. As we document in our report, data centers and other large computational loads are already participating in demand response programs, and US utilities and system operators have started introducing similar service options in their territories.

This should not be interpreted to suggest the US can fully meet its near-and medium-term electricity demands without building new peaking capacity or expanding the grid, not least due to other sources of electricity demand growth.[14] Instead, the findings highlight how flexible load strategies can help tap existing system headroom to more quickly integrate new loads, reduce the cost of capacity expansion, and enable greater focus on the highest-value investments in the electric power system.

While our study focused on the opportunity for flexibility from new data centers, it is worth emphasizing that flexibility could be a promising opportunity for other commercial, industrial, and residential loads, including existing customers. If a new data center finds it impractical or uneconomical to be flexible, it

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[13] Sivaram, V. 2025. "America May Not Need a Massive Energy Build-Out to Power the AI Revolution." Council on Foreign Relations. https://www.cfr.org/blog/america-may-not-need-massive-energy-build-out-power-ai-revolution.

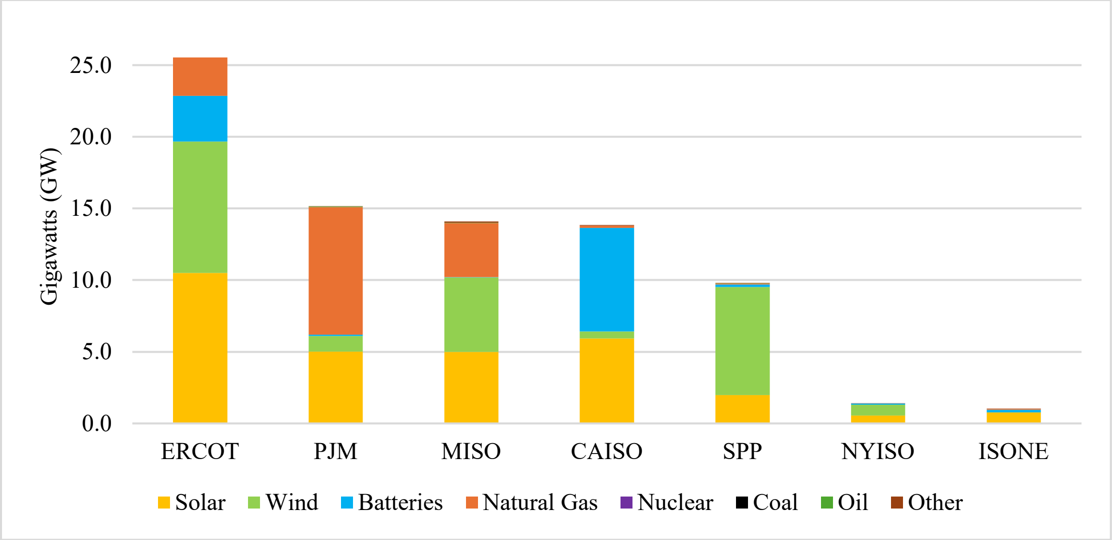
[14] As noted in our report, the precise requirements for power generation and transmission capacity to integrate these new loads reliably and affordably must be calculated with follow-up studies that remove the simplifying assumptions of these first order estimate.

could conceivably procure flexibility from other loads (e.g., as a "virtual power plant") to create similar system-wide benefits. Similarly, measures to improve the energy efficiency of the existing US building stock can support load additions by putting downward pressure on system peaks.

II. Streamlining Grid Access Can Unlock New Power Generation

Just as flexible loads help make better use of existing infrastructure, an approach that embraces flexible generation interconnection can accelerate the addition of new power resources, reducing the number of valuable projects that remain stuck in interconnection queues for years while waiting for costly upgrades. Despite the need for new generation, inefficiencies in grid connection have become a major barrier, with interconnection queue capacity quadrupling since 2010 to nearly 2,600 gigawatts[15] and project developers now identifying interconnection as a leading cause of project cancellations.[16] While FERC Order 2023 was a constructive step, these inefficiencies appear likely to persist without further reforms.

Figure 3: Electric Generation Capacity Additions by Market and Fuel, 2021-2023[17]



While most US markets struggle with these delays, the Electric Reliability Council of Texas (ERCOT) has taken a different approach that is achieving significantly greater performance:

- Between 2021-2023, ERCOT interconnected at least 70% more generation capacity than any other ISO/RTO,[18] despite serving a load that is only half of PJM's peak load (Figure 3).
- ERCOT has the fastest interconnection processing rate of any market, requiring nearly 2X less time than markets like PJM and NYISO in terms of duration from interconnection request to interconnection agreement.[19]

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[15] Rand, J., N. Manderlink, W. Gorman, Ryan H.W., et. al. 2024. *Queued Up: Characteristics of Power Plants Seeking Transmission Interconnection As of the End of 2023*. Lawrence Berkeley National Laboratory. https://emp.lbl.gov/queues.

[16] Nilson, Robi, Ben Hoen, Joseph Rand. 2024. *Survey of Utility-Scale Wind and Solar Developers Report*. Lawrence Berkeley National Laboratory. https://emp.lbl.gov/publications/survey-utility-scale-wind-and-solar.

[17] Chart created by the author based on data sourced from EIA and EPA.

[18] This estimate is conservative, because it relies on EIA's definition of operational capacity and does not account for a material volume of generators that are synchronized but not yet declared fully commercially operational.

[19] Rand, Joseph, Nick Manderlink, Will Gorman, Ryan Wiser, Joachim Seel, Julie M. Kemp, Seongeun Jeong, and Fritz Kahrl. *Queued Up: 2024 Edition, Characteristics of Power Plants Seeking Transmission Interconnection As of the End of 2023*. 2024.

- For interconnection requests from 2000-2018, ERCOT (30%) had the second-highest project completion rate after ISO-NE.[20]

The key difference is that several electricity markets, including PJM, impose substantially higher barriers to entry for new generators seeking to connect to the transmission system. In contrast, ERCOT allows generators to freely connect and, once online, manages their grid impacts with real-time operational tools, while pursuing transmission upgrades through a separate planning process – an approach known as "connect and manage."[21]

Under the more restrictive approach, new proposed generators are required to undergo rigorous studies that frequently trigger the need for extensive grid upgrades, for which the full cost is generally assigned to the proposed generators. This can require years of study and often leads to cascading project withdrawals, as the assigned costs make the projects economically unviable, thus triggering the need for additional studies. To offer an analogy, this is akin to if President Eisenhower had required commercial truck fleets to pay upfront for the cost of the Interstate Highway System before commencing its construction.

ERCOT's unique market structure means that other markets cannot easily replicate its approach without structural reform.[22] However, there are meaningful steps other markets can take to improve their interconnection performance, which FERC and other policymakers can encourage, including:

- *Adopt less restrictive treatment of Energy Resource Interconnection Service (ERIS):* FERC created ERIS in Order 2003 to provide a less restrictive option for generator interconnection, but it is often treated restrictively or otherwise discouraged. To address this, transmission providers can adopt ERIS treatment that is more consistent with the intended purpose of the service. [23] [24] [25]
- *Enable new generators to use grid capacity reserved for existing generators*: FERC could establish clear and consistent rules for Surplus Interconnection Service, ensuring that all transmission providers provide a streamlined, workable study and evaluation process for new energy resources to share interconnection rights with existing power plants that aren't fully using the rights they have been allocated.[26]
- *Adopt an interconnection "entry fee" for proactively planned capacity:* FERC can encourage transmission providers to allow new proposed generators to proceed quickly with upfront certainty by specifying in advance the cost information in exchange for taking on some of the cost of planned transmission buildout.[27]

Some markets have proposed to address this dilemma by changing long-standing market rules to prioritize certain types of generators over others in the interconnection process. Unfortunately, this

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[20] Ibid., 29.

[21] Norris, T. H. 2023. *Beyond FERC Order 2023: Considerations on Deep Interconnection Reform.* NI PB 23-04. Durham, NC: Nicholas Institute for Energy, Environment & Sustainability, Duke University. https://nicholasinstitute.duke.edu/publications/beyond-ferc-order-2023-considerations-deep-interconnection-reform.

[22] Unlike other markets, as an energy-only market without a capacity market, ERCOT's interconnection process is not delayed by studies that identify the network upgrades required to guarantee that the newly connected generators can sell their capacity, nor does it require generators to fund such network upgrades, which often undermines generators' financial viability and prompts projects cancelations.

[23] Norris, T.H. 2024. Pre- and Post-Workshop Comments for Staff-Led Workshop on Innovations and Efficiencies in Generator Interconnection. FERC Docket No. AD24-9-000. https://elibrary.ferc.gov/eLibrary/docketsheet?docket_number=ad24-9

[24] Enel North America. 2024. Pre-Workshop Comments for Staff-Led Workshop on Innovations and Efficiencies in Generator Interconnection. FERC Docket No. AD24-9-000. https://elibrary.ferc.gov/eLibrary/docketsheet?docket_number=ad24-9

[25] Joint Post-Workshop Comments of RMI, Clean Energy Buyers Association, Conservative Energy Network, et al. Docket No. AD24-9-000

[26] Farmer, M., and A. Silverman. 2025 *Unlocking the Power of Surplus Interconnection: Barriers Opportunities, and Strategic Solutions*. GridLab. https://surplusinterconnection.s3.us-east-1.amazonaws.com/2025-02-21_GridLab_Surplus_Interconnection_Barriers_Report.pdf

[27] Gramlich, R. et al. "Unlocking America's Energy: How to Efficiently Connect New Generation to the Grid." 2024. https://blog.advancedenergyunited.org/reports/unlocking-americas-energy

appears to be a temporary fix at best and, at worst, could result in lasting damage to business confidence in the integrity of market rules that discourages future private investment.

III. Near-Term Solutions Buy Time and Capital for Long-Lead Resources

Immediate additions of flexible loads and generators can provide a bridge that buys time and saves capital while power system planners scale up longer-lead-time resources, including transmission expansion, clean firm generation,[28] and long-duration energy storage. Solar and wind backed by lithium-ion battery storage will continue to play a major role, but in many jurisdictions, a feasible and cost-optimal long-term portfolio will require a mix of variable renewables, clean firm generation, and other balancing resources. While near-term solutions can alleviate pressure, sustained investments in these foundational resources are necessary to ensure the US can reliably meet demand growth into the 2030s and beyond.

A complete discussion of these long-lead resources is beyond the scope of this testimony, but a few key points bear emphasis. First, projects that require on the order of a decade to develop and construct are unlikely to make a material contribution in response to near and medium-term load growth. However, this does not diminish their importance. To the contrary, these resources will be vital to sustaining reliability, affordability, and progress on decarbonization beyond the next decade, especially as the “lowest hanging fruit” associated with more readily scalable resources is depleted.

Second, the high upfront capital expenditures typically associated with long-lead resources make them particularly sensitive to policy and regulatory uncertainty. Stable federal and state policies are critical to reducing financing risk and ensuring these projects can be developed at reasonable cost. For example, a repeal of the Inflation Reduction Act’s technology-neutral tax credits or a rollback of loan guarantees from the Department of Energy’s Loan Programs Office would likely have a crippling effect on investments in advanced nuclear, carbon capture and storage, and other next-generation energy technologies. Similarly, trade policies that increase the cost of essential input materials, such as steel, transformers, and rare-earth elements, could significantly impact project viability.

Third, these high upfront capital expenditures generally require higher electricity rates, especially to the extent that federal and state incentives are rolled back. With ratepayers already facing rising power bills across the US, each jurisdiction will inevitably face limits to how many large, capital-intense, long-lead projects it can bear. This underscores the importance of sophisticated, proactive planning to identify and prioritize the highest value projects, such as through the multi-value long-term scenario-based transmission planning required by FERC Order 1920.

Fourth, a hasty over-build of natural gas infrastructure in response to load growth could undermine private investments in clean firm technologies like advanced nuclear and enhanced geothermal, while exposing ratepayers to the risk of rising gas prices and market volatility. If investors perceive that policymakers are tilting the playing field to favor gas over other resource options, or that gas overbuild could depress capacity market prices, they are less likely to make higher-risk, long-term investments in clean firm technologies.

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[28] “Clean firm” generally refers to electricity generation technologies that produce low or zero greenhouse gas emissions while being dispatchable, such as nuclear, geothermal, carbon capture and storage, hydropower with storage, and potentially green hydrogen-fueled power plants and some long duration storage systems.

IV. Conclusion

The United States has the infrastructure, resources, and technological capability to meet growing electricity demand. By leveraging the flexibility of new large loads, streamlining generator interconnection, and making strategic investments in long-lead resources, policymakers can ensure a reliable, affordable, and sustainable power system for the future. While near-term solutions such as load flexibility and more efficient interconnection processes can help maximize existing infrastructure, these measures should be complemented by long-term investments in transmission expansion, clean firm generation, and other advanced energy technologies. Achieving this balance will require a stable policy environment that encourages private investment and avoids reactionary decisions that could undermine market confidence.